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Nonspecific chronic low back pain patients are deconditioned and have an increased body fat percentage

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The aim of this cross-sectional study was to compare data on the level of aerobic capacity and body composition of nonspecific chronic low back pain (CLBP) patients with normative data matched for sex, age and level of sporting activity. The study population consisted of 101 outpatients with nonspecific CLBP who had entered a rehabilitation programme. Results were as follows: the mean (standard deviation) aerobic capacity (VO_{2max}) of CLBP patients was significantly ($P < 0.001$) lower 7.3 (5.6) ml/kg lean body mass/min as compared with the normative data. The mean (standard deviation) body fat percentage of the patients was significantly ($P < 0.001$) higher 3.9 % (5.9) as compared with the normative data. These results provide evidence of a reduced level of aerobic capacity and an increased body fat percentage in nonspecific CLBP patients compared with

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Keywords: aerobic capacity, chronic low back pain, lean body mass-based Åstrand bicycle test

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Introduction

Patients with nonspecific chronic low back pain (CLBP) often report that they experience a reduced level of activity as a result of their pain problems. As a result of a long-term reduction in levels of activity, a 'deconditioning syndrome' has been proposed to describe these patients (Mayer *et al.*, 1985; Kohles *et al.*, 1990; Wittink *et al.*, 2000). A major objective among patients and professionals in rehabilitation is to increase the level of activities (Boonstra *et al.*, 2007). Because of this deconditioning theory training of aerobic capacity is used in many rehabilitation programmes for non-specific CLBP patients (Hurri *et al.*, 1991; Nielens and Plaghki, 1994; Jette and Jette, 1996; Brox *et al.*, 2005).

Despite the deconditioning theory, it is not clear whether nonspecific CLBP patients actually suffer from a reduced aerobic capacity. Conflicting results have been reported regarding deconditioning (Smeets *et al.*, 2006). However, differences in levels of physical sporting activity may be important. So it is necessary that studies of nonspecific CLBP patients incorporate information about the preceding level of physical sporting activity when analyzing aerobic capacity.

Deconditioning may also affect body composition. Lean body mass (LBM), that is, body mass minus the mass of fat, decreases during 30 days bed rest, whereas body weight does not change during that period (Greenleaf, 1997). This finding suggests that the percentage of body fat may increase and the percentage of muscle mass may

decrease as a result of a reduction in physical sporting activity in nonspecific CLBP patients. Similar to aerobic capacity research, conflicting results have been reported regarding body fat percentage in nonspecific CLBP patients (Toda *et al.*, 2000; Verbunt *et al.*, 2001).

The aim of this study was to analyze the level of aerobic capacity and the body fat percentage of nonspecific CLBP patients and to compare the data with normative data from healthy participants corrected for age, sex and level of sporting activity. The second aim was to analyze the association between the level of aerobic capacity and body fat percentage and the duration of complaints.

Methods

Data from 101 outpatients diagnosed with nonspecific CLBP were included in this cross-sectional study (Table 1). Data were gathered at the University Medical Center Groningen, The Netherlands, as part of the routine assessment of the patients before the rehabilitation programme. Those who entered the programme were between 18 and 65 years of age and had suffered from nonspecific CLBP for at least 3 months.

Assessments

Results from a LBM-based Åstrand submaximal bicycle test were analyzed to estimate aerobic capacity expressed in absolute values and normalized-for-weight maximum oxygen uptake (VO_{2max}) values (Hodseldmans *et al.*, 2001, 2008). Before starting the bicycle test, LBM was measured according to the Durnin and Womersley (1974)

Table 1 Clinical characteristics of the nonspecific CLBP patients

(n = 101)	n (%)
Female	47 (46)
Sport activity 'Untrained'	53 (52)
Sport activity 'Recreational'	36 (36)
Sport activity 'Duration'	12 (12)
	Mean (SD)
Age (years)	39.2 (9.6)
Height (m)	1.74 (0.09)
Weight, body mass (kg)	81.9 (15.5)
Duration of complaints (months)	64.1 (68.4)

CLBP, chronic low back pain; SD, standard deviation.

protocol using a skinfold calliper (Vos, 2004). The participants started cycling at a predetermined workload of 0.5 W/kg LBM at a constant rate of 60 per minute. After 2 min cycling, the workload was increased to 1.5 W/kg LBM. If the heart rate (HR) remained below 120 beats/min the workload was increased by 0.5 W/kg LBM every 2 min. Once the HR exceeded 120 beats/min, the patient cycled for 6 min at a fixed workload to reach a steady-state phase, meaning that the HR did not vary more than ± 5 beats/min during the final 2 min of exercise. The $\dot{V}O_{2\max}$ was estimated using the Binkhorst calculation based on the linear association between HR and increase in oxygen uptake for men and women (Binkhorst, 1986). This test has previously been proven reliable and feasible in nonspecific CLBP patients and valid in healthy participants (Hodseltmans *et al.*, 2008).

All patients provided information on the average number of hours per week they had spent undertaking sporting activities over the preceding half year and this data was used to classify each patient using the same criteria as used for the normative data. People who undertook sports for less than 1–2 h per week or not at all for at least half a year were categorized as 'untrained'. People who undertook sports for 1–2 h per week for at least half a year were categorized as 'recreational' and people who undertook sports for 3–6 h per week for at least half a year were categorized as 'duration' (Vos, 2004).

Data analyses

The mean and standard deviation (SD) were calculated for all variables. The aerobic capacity ($\dot{V}O_{2\max}$) and body fat percentage were also expressed as predicted percentages, based on normative data. Differences in scores between observed and predicted scores that were matched on age, sex and level of sporting activity were then analysed using paired *t*-tests. Correlations between duration of complaints and aerobic capacity ($\dot{V}O_{2\max}$) and body fat percentage expressed as a predicted percentage were calculated with Spearman's rho. Effect size (ES) indices between the observed and the predicted values for aerobic capacity and body fat percentage were calculated as a $\text{mean}_{\text{difference}}/\text{sd}_{\text{pooled}}$ (Cohen, 1988; Portney and Watkins, 2000). Data analyses were

performed using the Statistical Package for the Social Sciences (SPSS 14.0 for Windows; SPSS Inc., Chicago, Illinois, USA).

Results

The nonspecific CLBP patients had a significantly lower aerobic capacity (mean 7.3, SD 5.6) as compared with the normative data matched for sex, age and level of sporting activity (Table 2). Mean (SD) body fat percentage was 3.9% (5.9), significantly higher as compared with the normative data.

The ES between the observed and the predicted aerobic capacity was large, whereas the ES between the observed and predicted body fat percentage was moderate (Table 2). No correlation was found between the duration of complaints and aerobic capacity ml/kg LBM/min ($\dot{V}O_{2\max}$), expressed as a predicted percentage (Table 3).

Discussion

Nonspecific CLBP patients have a reduced level of aerobic capacity as well as a higher percentage of body fat compared with healthy controls matched for age, sex and level of physical sporting activity. These results support the hypothesis that nonspecific CLBP patients are clinically deconditioned and have an increased body fat percentage. Significantly lower aerobic capacity ($\dot{V}O_{2\max}$) in nonspecific CLBP patients compared with the normative data has been found in several studies (Velde

Table 2 Results of the LBM-based Åstrand submaximal bicycle test and the measured body fat percentage

Variables	Patients Mean (SD)	Predicted data Mean (SD)	Mean Δ (SD)	ES
$\dot{V}O_{2\max}$ ml/kg LBM/min (n = 91)	45.7 (9.6)	53.1 (6.9)	-7.3 (5.6)*	0.88
$\dot{V}O_{2\max}$ ml/kg BM/min (n = 91)	32.1 (7.3)	38.6 (6.1)	-6.5 (5.6)*	0.97
$\dot{V}O_{2\max}$ l/min (n = 91)	2.5 (0.6)	3.0 (0.5)	-0.4 (0.2)*	0.91
Body fat, % (n = 101)	30.4 (8.2)	26.4 (6.1)	3.9 (5.9)*	0.55

Predicted data: are based on normative data, with each patient being matched for age, sex and sport activity.

BM, body mass; ES, effect size; LBM, lean body mass; SD, standard deviation; $\dot{V}O_{2\max}$, maximum oxygen uptake.

*Significant $P < 0.001$.

Table 3 Correlation between aerobic capacity and body fat percentage expressed in percentage predicted with duration of complaints (Spearman rho)

Variables	Mean % predicted (SD)	Duration complaints Spearman Rho (P value)
ml/kg LBM/min % predicted	86 (11.4)	-0.19 (0.082)
ml/kg BM/min % predicted	83 (14.1)	-0.05 (0.649)
l/min % predicted	86 (8.9)	-0.22 (0.059)
Body fat % predicted	116 (26.4)	-0.07 (0.967)

SD, standard deviation.

van der and Mierau 2000; Keller *et al.*, 2001; Duque *et al.*, 2009). However, Nielsens and Plaghki (2001) and Wittink *et al.* (2000) both reported that aerobic capacity in women with nonspecific CLBP is not reduced. A potential explanation for this finding put forward by these investigators is that women may maintain their level of physical activity by undertaking household tasks. Their findings contrast with our finding that women with nonspecific CLBP also have a lower level of aerobic capacity compared with healthy female participants. A potential explanation for our finding might be that the women in our study have reduced their level of physical sporting activity despite undertaking household activities. This explanation is supported by the fact that the actual physical activity of daily living (PAL) in nonspecific CLBP patients was less than their habitual PAL (Verbunt *et al.*, 2005).

No significant relationship was found between aerobic capacity ($\dot{V}O_{2\max}$) and the duration of complaints. Therefore, we could not confirm that duration of complaints contributes to deconditioning in nonspecific CLBP patients. Our results are in agreement with those of other studies (Wittink *et al.*, 2000; Verbunt *et al.*, 2003).

ES indices were used to determine whether there was a meaningful difference between nonspecific CLBP patients and healthy participants. The results of this study show clinically large ESs between patients and healthy participants with respect to aerobic capacity ($\dot{V}O_{2\max}$), and clinically moderate ESs in relation to body fat percentages (Portney and Watkins, 2000; Middel *et al.*, 2001).

One limitation of this study is that we were not able to gather data regarding the quality and decline of PAL.

Conclusion

Nonspecific CLBP patients have a reduced level of aerobic capacity and an increased body fat percentage.

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